Marine Resiliency Study

Prospective, Longitudinal Assessment of Risk and Protective Factors for Stress Injuries and Illnesses in Ground Combat Marines

(MRS).

2010 Update

Dewleen G. Baker
William P. Nash
Brett T. Litz
Daniel T. O'Connor
Mark A. Geyer
Victoria B. Risbrough
Caroline M. Nievergelt
Gerald E. Larson
& the MRS team

USMC Combat and Operational Stress Control (COSC)

VA Center of Excellence CESAMH Stress and Mental Health

Study Overview and Current Status

Dewleen G. Baker

USMC Combat and Operational Stress Control (COSC)

VA Center of Excellence
CESAMH
Stress and Mental Health

What is the Marine Resiliency Study (MRS)?

- A collaboration across multiple organizations:
  - U.S. Marine Corps
  - Department of Veterans Affairs
  - Navy Medicine
- To follow a large cohort of ground combat Marines throughout an entire deployment cycle
- To learn what factors predict ***risk*** and ***resilience*** for combat stress injuries and stress illnesses **across systems**:
  - Genetic, biological and psychophysiological
  - Psychological and psychiatric
  - Social (unit and family) and spiritual
  - Environmental (stressor exposures)
- To learn how better to ***prevent*** stress illnesses

The Cutting Edge of Combat Stress Science

- We already know a lot about risk and resilience for stress illnesses like posttraumatic stress disorder (PTSD) in:
  - Civilian victims of accidents or assaults
  - Veterans of past wars
- But no previous research has:
  - Studied combat stress injuries in ground combat Marines
  - Been **prospective** and **longitudinal** (evaluating the same individuals before and after a combat deployment)
  - **Simultaneously** studied biological, psychological, social, and environmental factors
  - Attempted to plot **trajectories** across the

Methodology

- **Participants**
  - Consenting members of 1st Marine Division infantry battalions from MCAGCC 29 Palms or Camp Pendleton, California
  - Goal: enroll and retain as many members of each participating battalion as possible to ensure representative cohorts
- **Data collection time points**
  - Target N = 3000 Marines deployments
  - One month before deployment to Iraq or Afghanistan
  - One week post-deployment

Six-wide semi-permanent data collection trailer at MCAGCC 29 Palms

Outcome Variables and Measures

Variables	Measures
PTSD symptom severity trajectories (primary outcome)	• Clinician-Administered PTSD Scale (CAPS) • PCL
Orange Zone stress injury symptom severity	• Significant though subclinical scores on CAPS, PCL, Beck Depression Inventory (BDI-II) or Beck Anxiety Inventory (BAI) • Composite of scores on specific items on measures of coping, distress, dissociation, physical functioning, and cognitive functioning, attitudes, beliefs, and affectivity
Physical and mental health	• Military health records • Self-reported health service usage • Standard Form Health Status Questionnaire (SF-12)

Predictor Variables and Measures (Partial List)

Variable Categories	Measures
Stressor exposures	• Deployment Risk and Resilience Inventory (DRRI) Combat Experiences, Post-Battle Experiences, Deployment Concerns, and Deployment Environment scales • Unit deployment chronology (obtained from unit leadership)
Psychological and psychiatric predictors	• Positive and Negative Affectivity Scale (PANAS) • Connor-Davidson Resilience Scale (CD-RISC) • Brief Cope • Dissociative Experiences Scale (DES) • Live Events Checklist (LEC) • OIF/OEF deployment history survey • Depression or anxiety symptoms (BDI-II, BAI) • Substance abuse or dependence (AUDIT, DAST) • Peritraumatic Dissociative Experiences Questionnaire (PDEQ)

Predictor Variables and Measures (Partial List)

Variable Categories	Measures
Biomarkers	• Norepinephrine and epinephrine in plasma & urine • Cortisol in saliva • Neuropeptide-Y (NPY) in plasma • C-reactive protein in plasma • Caffeine and cotinine (measure of tobacco use) in plasma
Hemodynamics	• Basal blood pressure and heart rate • Cardiac output and total peripheral resistance (calculated)
Psychophysiological predictors	• Acoustic startle threshold (in response to brief tone pulses) • Fear-potentiated startle (in anticipation of unpleasant visual stimuli) • Prepulse inhibition (PPI) and startle habituation • Heart rate variability

Data Collection Timing & Logistics

T1	Seven-month War Zone Deployment	T2	T3	T4
1 Month Pre-deployment		1 Week Post-deployment	3 Months Post-deployment	6 months Post-deployment
• Informed consent • Questionnaires • Private interview • Blood, urine, saliva • Startle reactivity • Heart rate, BP • Neuropsychological performance tests		• Questionnaires	• Questionnaires • Private interview • Blood, urine, saliva • Startle reactivity • Heart rate, BP • Neuropsychological performance tests	• Questionnaires • Private interview • Blood, urine, saliva • Startle reactivity • Heart rate, BP • Neuropsychological performance tests

Participant Enrollment and Retention (as of May 2010)

Cohort	(T1) Pre-deployment Enrollment	Deployed to:	(T2) 1 Week Completers	(T3) 3 Month Completers	(T4) 6 Month Completers
1	**315**	OIF	**307** (97%)	**278** (88%)	**268** (85%)
2	**721**	OIF	**671** (87%)	**539** (75%)	**508** (70%)
3	**671**	OEF	In progress	—	—
Total	**1707**		**978** (94%)	**817** (79%)	**776** (75%)

- Future scheduled enrollments:
  - Cohort 4, Fall 2010
  - Cohort 5, Spring 2011

Initial Findings From First Two Cohorts

Dewleen G. Baker
Brett T. Litz
Daniel T. O'Connor
William P. Nash

USMC Combat and Operational Stress Control (COSC)

VA Center of Excellence
CESAMH
Stress and Mental Health

Baseline Demographics, Part I

		MRS T1 (N = 1036)	USMC, 29 Palms (N = 11,477)*
Age	17-21	44%	37%
	22-30	53%	52%
	31+	3%	11%
Gender	Male	100%	95%
Race	White	76%	72%
	Hispanic	19%	15%
	Black	5%	7%
Rank	E1-E3	76%	41%
	E4-E9	22%	53%
	O1-O9	4%	5%
Marital Status	Married	28%	39%
	Not married	72%	61%

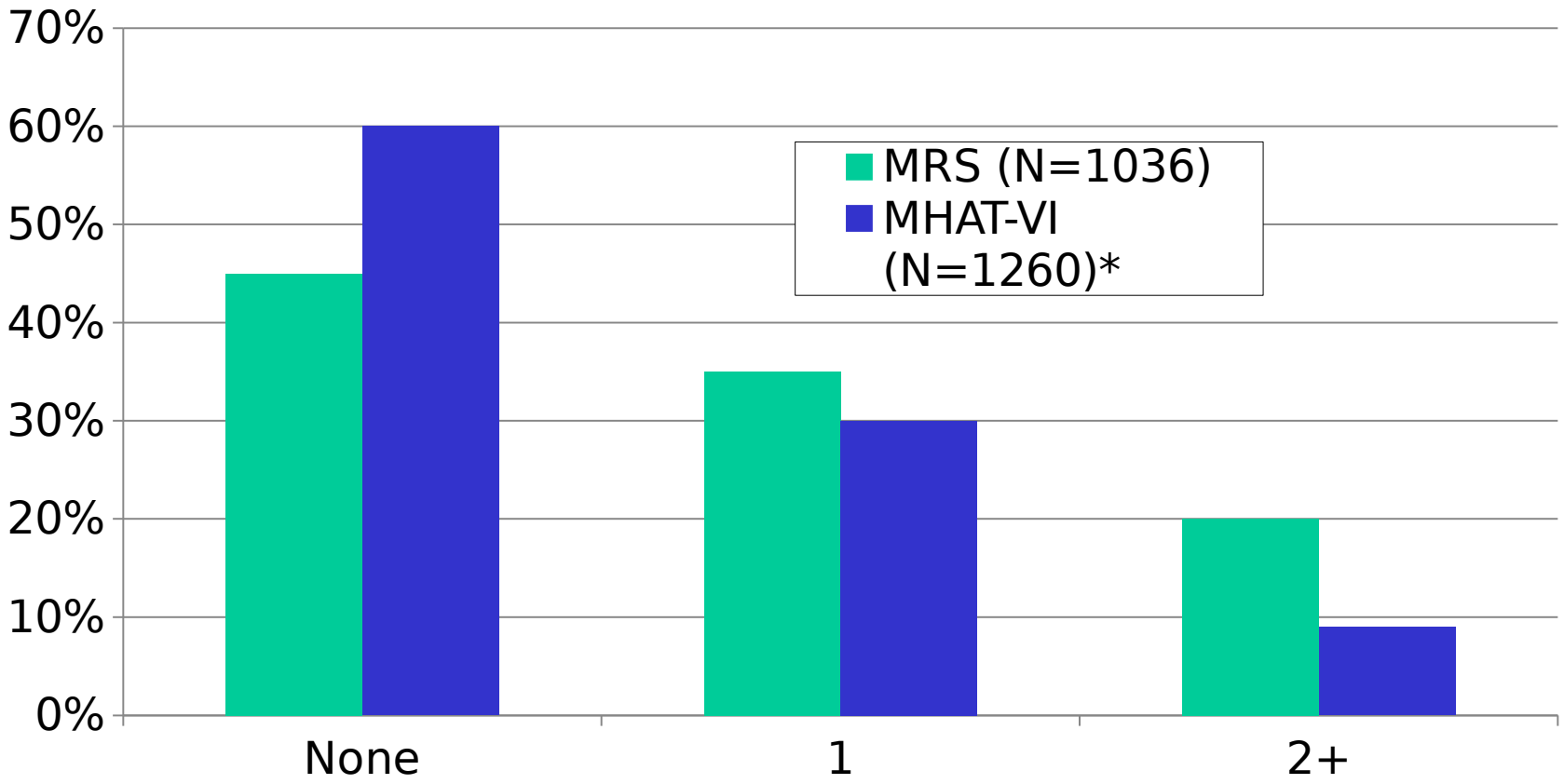
* Headquarters, Marine Corps, Demographics Update, June 2008

Baseline Demographics, Part II

		MRS T1 (N = 1036)	USMC as a whole (N = 192,883)*
Years of Svc	< 4	88%	59%
	4-6	6%	15%
	7-10	4%	10%
	11+	2%	16%
Education	< HS Grad/Equiv	2%	2%
	HS Grad/Equiv	69%	84%
	Some college	25%	4%
	Bacc. Degree+	4%	10%
Military Occupational Specialty	Combat Arms	89%	
	Combat Support	6%	
	Service Support	5%	

* Headquarters, Marine Corps, Demographics Update, June 2008

Number of Previous Deployments



*U.S. Army Mental Health Advisory Team Report surveying soldiers currently deployed to Operation Iraqi Freedom 07-09 (MHAT-VI), May 2009

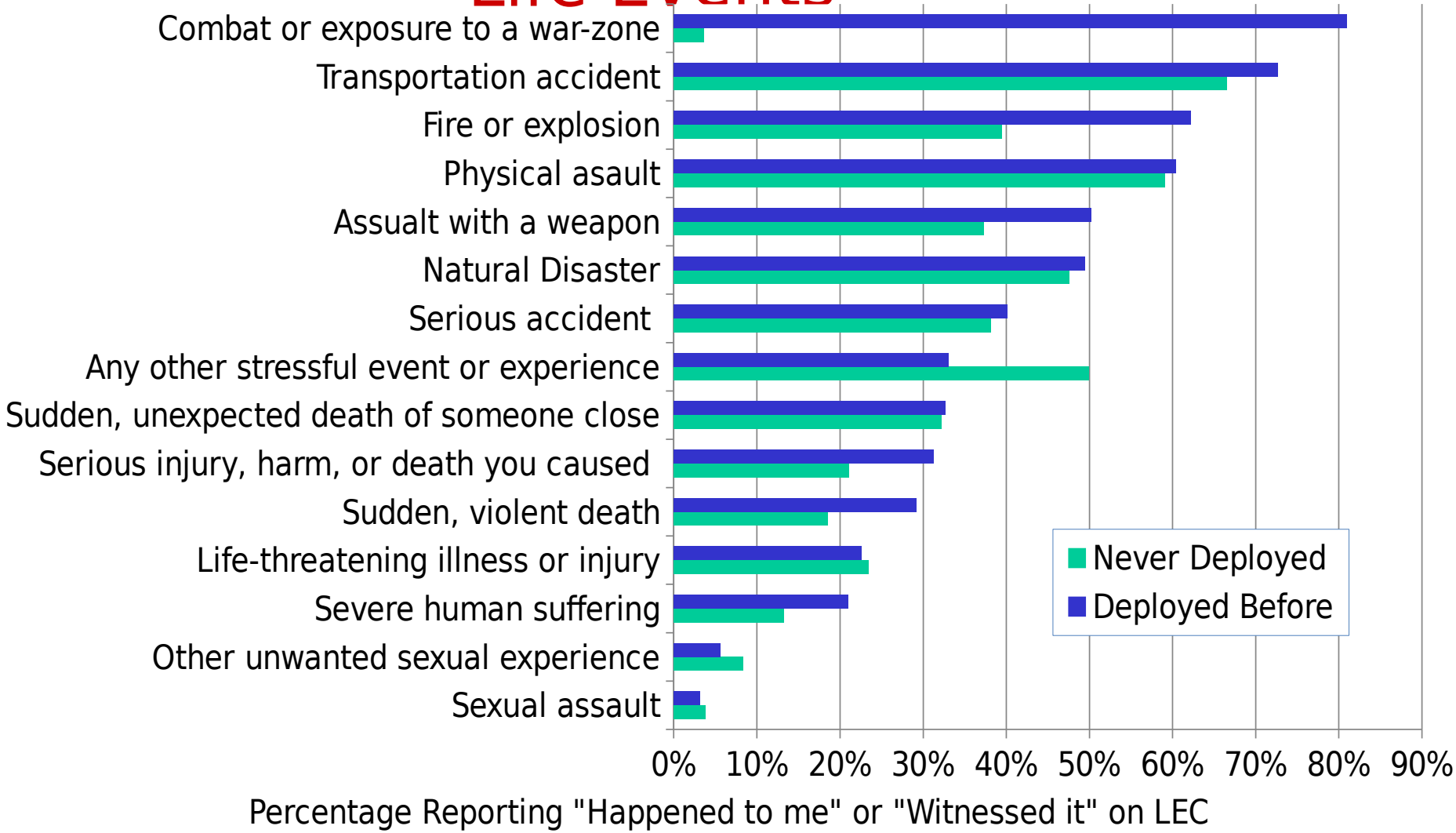
Baseline Pre-Deployment Status: Mental & Physical Health

		MRS T1 (N=1036)	Comparison Group	Effect Size (*d*)
Posttraumatic stress	PCL summary score	24.8 (10.6)	29.2 (13.0)†	0.38
	PTSD by CAPS interview	5.5%	3.6%‡	
Depression	BDI-II score	8.2 (8.8)		
Anxiety	BAI score	7.4 (8.4)		
Alcohol use	AUDIT score	9.2 (6.5)		
Drug use	DAST score	0.12 (0.02)		
Physical health	SF-12	52.8 (0.13)		

† Vasterling et al. (2006) U.S. Army cohort (N=961)

‡ Smith et al. (2008), PTSD by DSM criteria applied to PCL questionnaire score in Millennium Cohort Study combined sample of 50,128 service members, of whom 11,952 (24%) had deployed

Baseline Pre-Deployment Status: Prior Potentially Traumatic Life Events



Deployment-Related Stressors Reported at 1 Week Post-deployment

Deployment Risk & Resilience Inventory (DRRI) self-report scales	MRS T2 (N=978)	Vogt et al. 2008 (N=640)†	Effect Size *(d)*
Combat Experiences	15.0 (8.7)	40.7 (12.6)	2.05
Perceived Threat	30.7 (10.1)	45.6 (10.2)	1.44
Post-Battle Experiences	2.4 (2.9)	9.3 (3.9)	2.03
Deployment Environment	49.2 (11.9)	46.6 (12.7)	0.21
Life & Family Concerns	20.9 (6.3)	24.0 (7.3)	0.45

† For comparison, Vogt, Proctor, King, King, and Vasterling (2008) reported DRRI stressor scale scores in a cohort of 640 U.S. Army soldiers deployed to Iraq in 2003 and 2004, when fighting was more intense than during the deployment of the initial MRS cohort

Post-Deployment (T3) Mental & Physical Health Compared to Baseline (T1)

		MRS T1 (N=1036)	MRS T3 (N=815)	Effect Size *(d)*
Posttraumatic stress	PCL mean score	24.8 (10.6)	23.6 (9.5)†	0.04
	PTSD by CAPS	5.5%	4.8%‡	
Depression	BDI-II score	8.2 (8.8)	5.2 (7.5)	0.35
Anxiety	BAI score	7.4 (8.4)	5.0 (7.8)	0.30
Alcohol use	AUDIT score	9.2 (6.5)	6.9 (4.9)	0.39
Drug use	DAST score	0.12 (0.02)	0.03 (0.01)	0.17
Physical health	SF-12	52.8 (0.13)	52.8 (0.13)	0

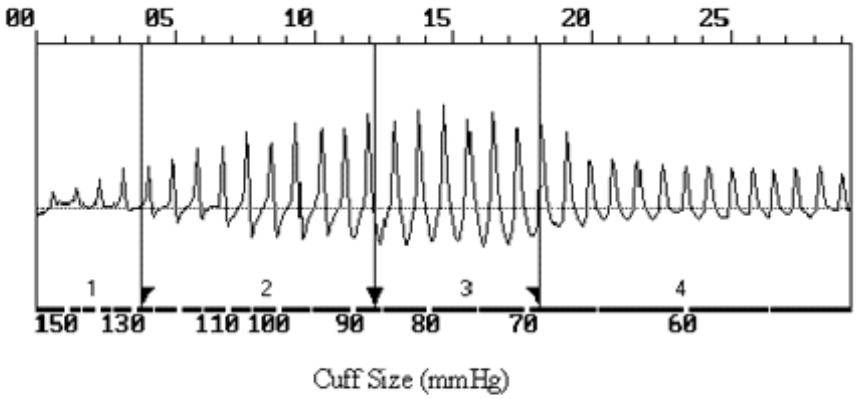
† For comparison, Vasterling et al. (2006) reported the mean PCL score of a U.S. Army cohort after deploying to Iraq 2003-2004 (N=654) to be 32.3 (SD 13.1)

‡ For comparison, Smith et al. (2008) reported 4.7% of N=11,952 service members in Millennium Cohort Study who had deployed 2004-2006 met DSM criteria for PTSD by PCL scores

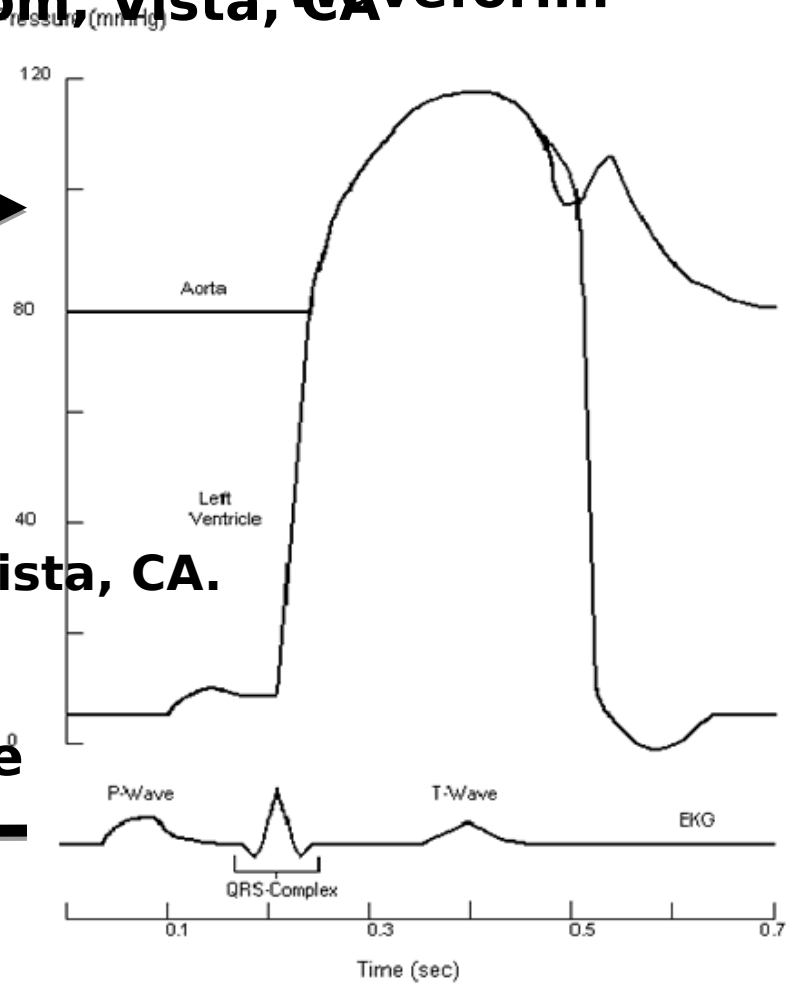
Blood Pressure & Hemodynamics in MRS

Dynapulse Non-invasive Oscillometric Pressure Waveform Analysis

Monitor: www.PulseMetric.com, Vista, CA Waveform:



Digital Representation of Pressure Waveform in Brachial Artery

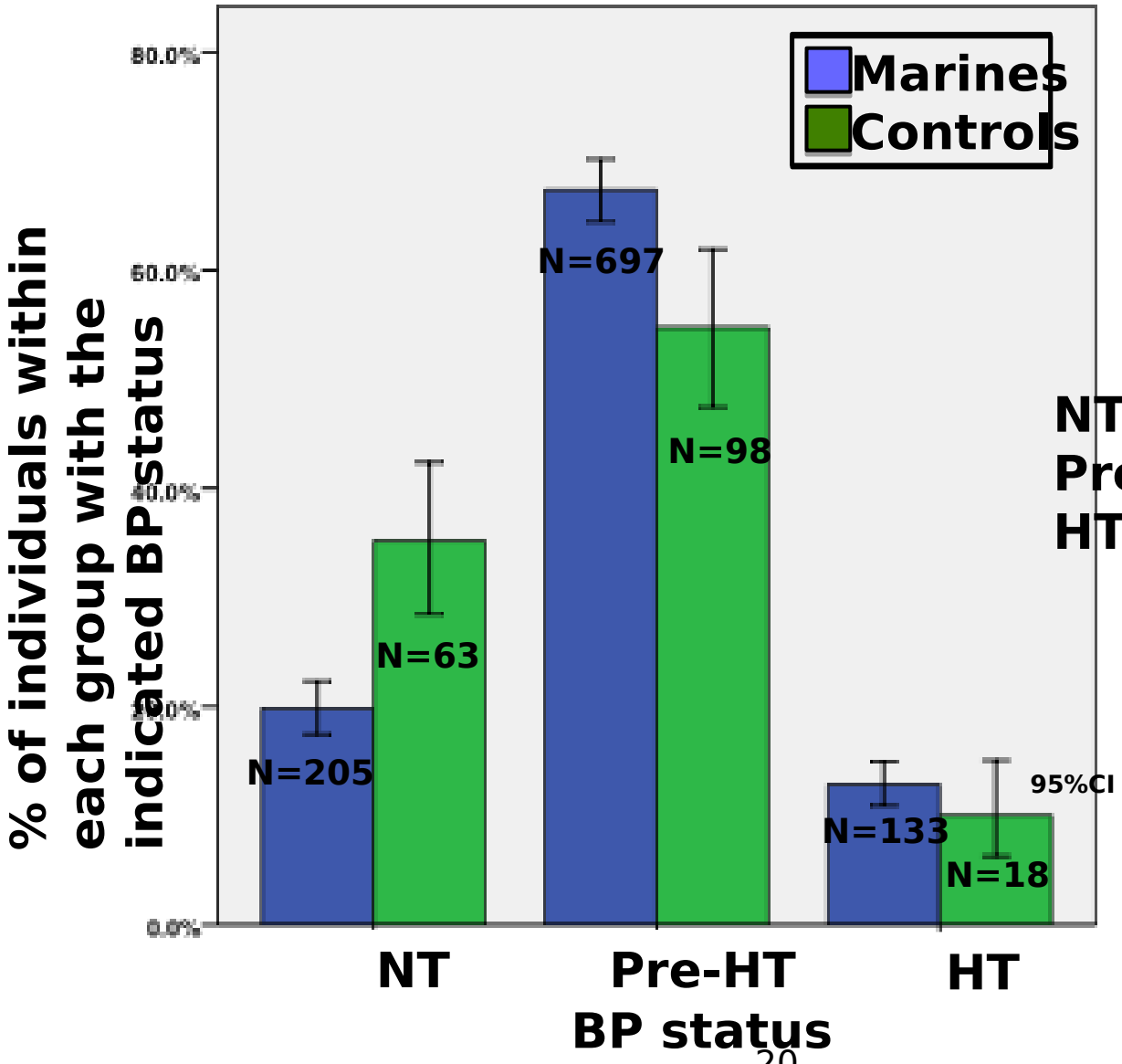


<www.PulseMetric.com>, Vista, CA.

tput:

- **Pressure: SBP, DBP, PP**
- **Flow: Cardiac Output, Stroke Volume**
- **Vascular: Systemic Resistance, Systemic Compliance**
- **LV: Contractility**

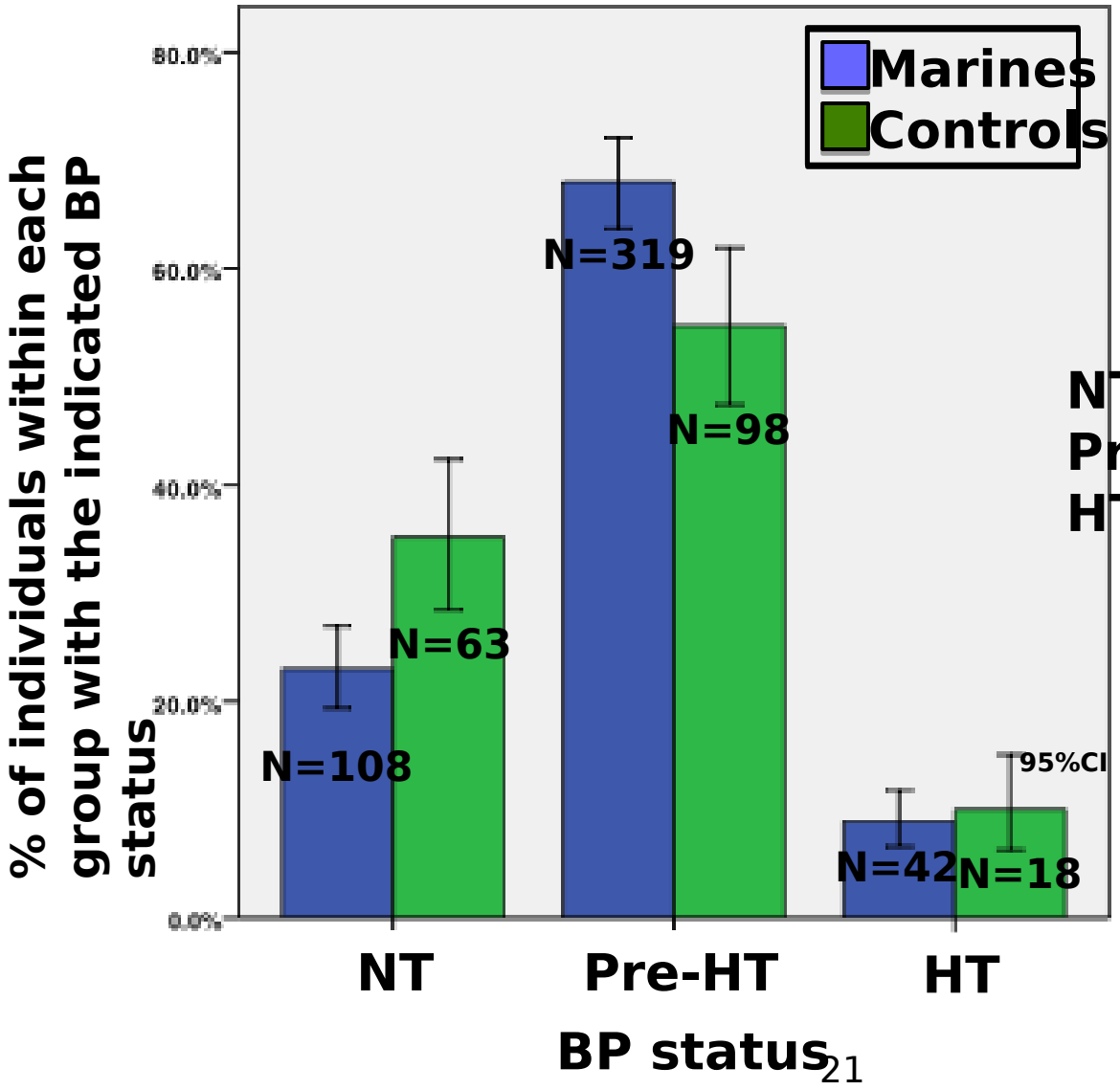
Blood Pressure U.S. Marines vs. Population Controls



Chi-sq=21.0
p<0.000028
Eta-sq=0.11

NT: Normotensive
Pre-HT: Pre-hypertens
HT: Hypertensive

Blood Pressure in Never-Deployed U.S. Marines vs. Population Controls



Chi-sq=10.98
p<0.004
Eta-sq=0.09

NT: Normotensive
Pre-HT: Pre-hypertensive
HT: Hypertensive

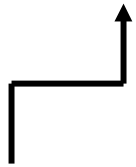
Hemodynamic Determinants of Blood Pressure

Flow = Pressure / Resistance

Pressure = Flow • Resistance

erial pressure = Cardiac Output • Systemic Vascular F

MAP = CO • SVR

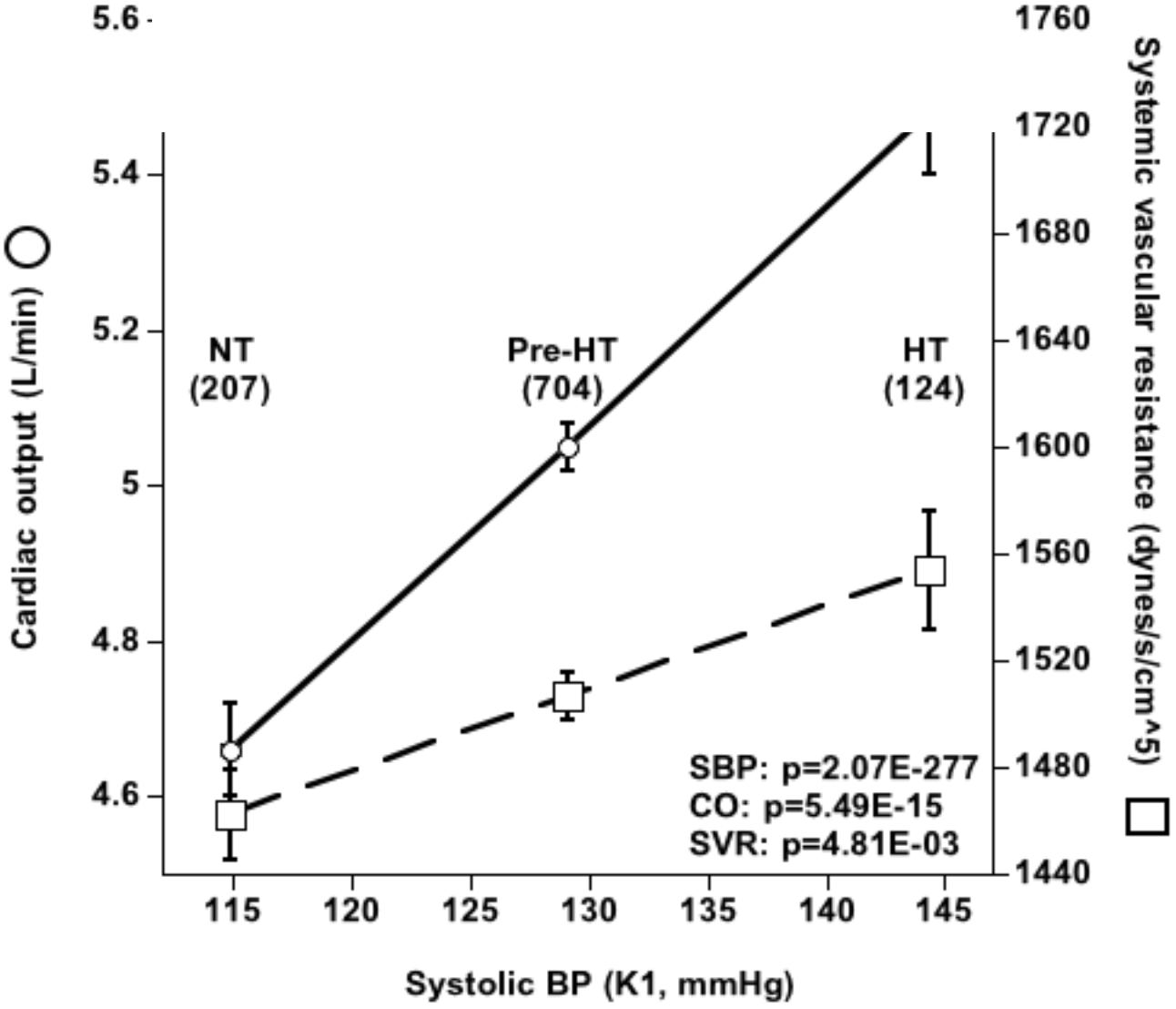


CO = Stroke Volume • Heart Ra

CO = SV • HR

Contractility (dP/dt)

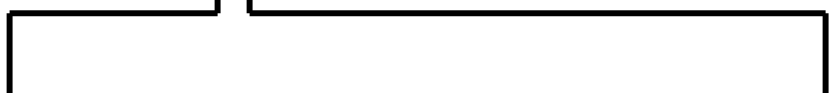
Blood Pressure in MRS: Heart Versus Vasculature



Hemodynamic Determinants of Blood Pressure

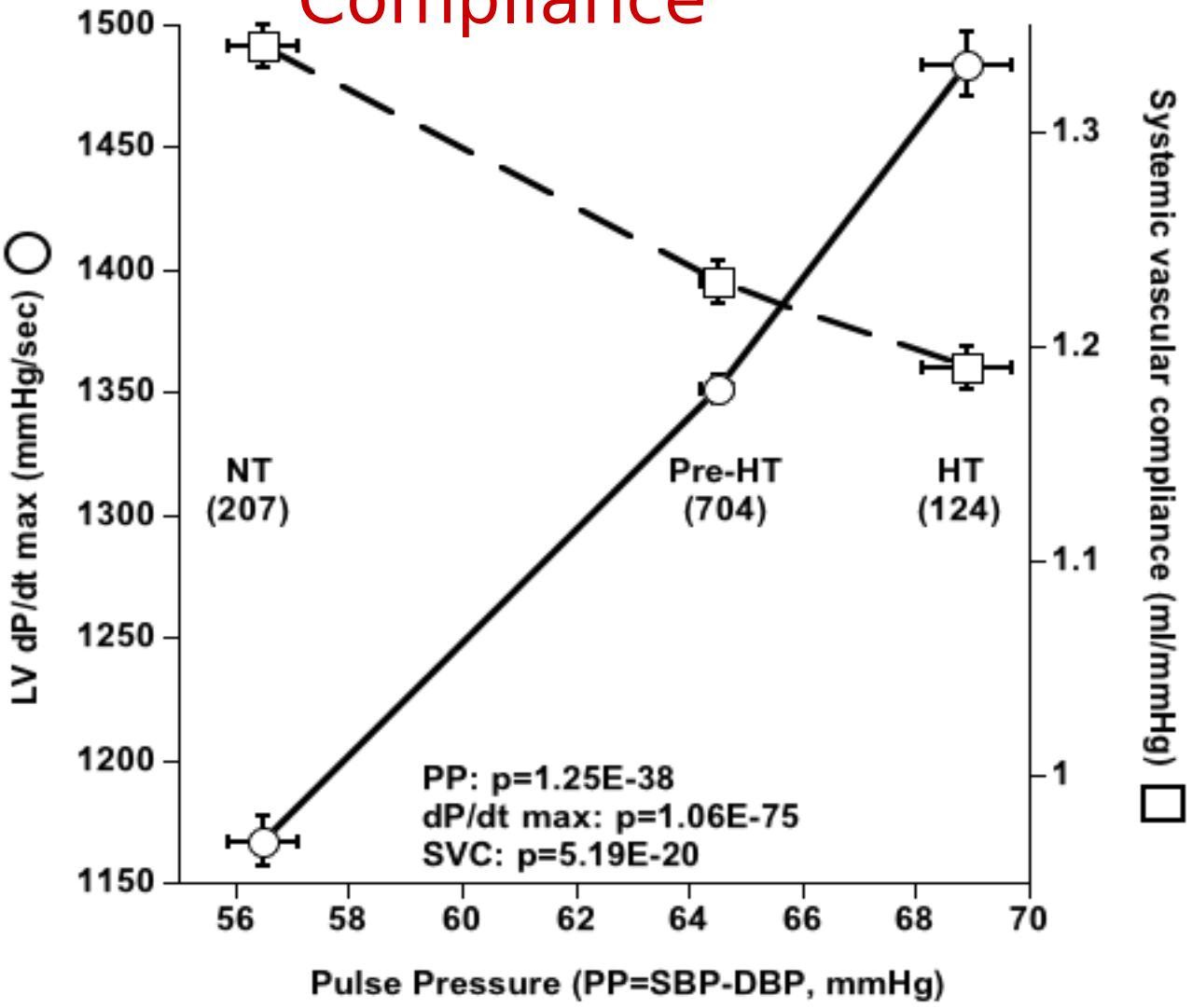
Pulse Pressure = Systolic BP - Diastolic BP

PP ↑ ∝ SBP - DBP



Compliance (C’)
Contractility (dP/dt)

Pulse Pressure (PP=SBP-DBP) in MRS: LV Contractility Versus Vascular Compliance



History of Prior Traumatic Brain Injuries at Baseline (T1, N=1036)

		If mTBI is defined by LOC< 30 min. or PTA ≤24 hrs.	If mTBI is also defined by AOC ("dazed, confused") w/o LOC or PTA
Any prior TBI established by interview		482 (47%)	633 (61%)
Number of prior TBIs	1	292 (28%)	286 (28%)
	2-4	185 (18%)	309 (30%)
	5+	5 (0.5%)	38 (4%)
Severity of prior TBIs	Mild	449 (43%)	613 (59%)
	Moderate	61 (6%)	61 (6%)
	Severe	0 (0%)	0 (0%)
Setting of prior TBIs	Deployment-related	43 (4%)	93 (9%)
	All other settings	439 (42%)	500 (48%)

New Traumatic Brain Injuries Reported Post-Deployment (T3, N=817)

		If mTBI is defined by LOC< 30 min. or PTA ≤24 hrs.	If mTBI is also defined by AOC ("dazed, confused") w/o LOC or PTA
Any new TBI established by interview		42 (6%)	86 (11%)
Number of prior TBIs	1	38 (5%)	72 (9%)
	2-4	4 (1%)	14 (2%)
	5+	0 (0%)	0 (0%)
Severity of prior TBIs	Mild	40 (5%)	85 (10%)
	Moderate	2 (0.2%)	2 (0.2%)
	Severe	0 (0%)	0 (0%)
Setting of prior TBIs	Deployment-related	27 (3%)	60 (7%)
	All other settings	15 (2%)	26 (3%)

Neurocognitive Performance Post-Deployment (T3) Versus Baseline (T1)

Automated Neuropsychological Assessment Metric (ANAM) Test	T1 Pre-Deployment	T3 Post-Deployment	t-value	p-value	Cohen's D
Simple Reaction Time	(N=685)	(N=685)			
Throughput score†	234.1 (27.4)	239.7 (26.9)	-5.25	<0.0001	0.19
Continuous Performance Test	(N-782)	(N=782)			
Mean Response time	369.4 (58.4)	370.1 (55.2)	-0.32	0.75	0.01
Omission errors‡	0.37 (1.2)	0.20 (1.0)	3.13	0.002	0.12
Commission errors	0.52 (0.8)	0.46 (0.7)	1.86	0.06	0.07

† **Simple Reaction Time** is a test of speed in responding to a recurring stimulus; **throughput score** is a measure of efficiency, reflecting speed in the context of accuracy

‡ **Continuous Performance Test** is a test of sustained vigilance while detecting and responding appropriately to targets; **omission errors** reflect lapses of attention

The Way Ahead for MRS

William P. Nash
Dewleen G. Baker
Brett T. Litz

USMC Combat and Operational Stress Control (COSC)

VA Center of Excellence
CESAMH
Stress and Mental Health

MRS: Future Priorities

- Complete enrollment of Marine battalions bound for OEF
- Complete post-deployment data collection with highest possible participant retention
- Plot trajectories of traumatic stress symptoms and functioning over four time points
- Test hypotheses about putative risk and protective factors both within and across systems over time
  - What resilience-promoting factors protect Marines from potential adverse effects of stressor exposures mediated by risk factors?
  - Are there ways the Marine Corps can maximize protective factors while minimizing risk?
- Establish metrics for the four stress zones of the

How Can MRS Help the USN & USMC Use the Stress Continuum Model for Prevention?

Green Zone	Yellow Zone	Orange Zone	Red Zone
READY	REACTING	INJURED	ILL
• No significant distress • No significant impairment of functioning in body, mind, and spirit	• Mild and transient distress or alterations in functioning • Disappears soon after sources of stress are gone • **"Normal"**	• More severe and persistent distress or alterations in functioning • Don't quickly disappear after sources of stress are gone • **Subclinical** in duration or severity	• Distress and/or alterations in functioning that cause persistent impairment • **Clinical** stress-related mental disorders

We must establish metrics to objectively define these two critical boundaries!

MRS Methodology To Define Orange Zone's Upper & Lower Boundaries

Two-pronged attack:

1. Analyze outcome and mediator (intermediate state) variables for significance of subthreshold scores
   - PTS symptom severity by CAPS interview or PCL
   - Panic anxiety
   - Generalized anxiety
   - Depression
2. Test significance of "syndromes" of naturally co-occurring distress, dissociation, and dysfunction indexed by individual items of tests used in MRS; e.g.,
   - Changes in self-confidence, emotional

MRS Goal:

To develop tools for the Marine Corps and Navy to better promote resistance, resilience, and recovery

Questions or comments?

USMC Combat and Operational Stress Control (COSC)

VA Center of Excellence
CESAMH
Stress and Mental Health